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ABSTRACT

The Munby system for coding classroom interaction is an observation system constructed to study the intellectual consequences of varying kinds of science teaching behaviors. The initial use of the system called for making judgments about small portions of teaching, arbitrarily determined from a transcript of the teaching in question. Recent work with the system to determine its validity resulted in a change in the scoring technique to permit coding a lesson directly or from a recording. The purpose of this manual is to describe this new coding procedure in detail. General directions for using the scoring sheet are given first. These are followed by detailed descriptions of how the classifications are to be interpreted for the Instrumentalist-Realist dimension. This is followed by a brief guide to the use of the Intellectual Independence and Intellectual Dependence dimension. An annotated bibliography is provided which includes references to the Munby System and to works which are related to this approach. The Munby System itself is appended. (Author/MA)

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SCORING MANUAL FOR THE MUNBY SYSTEM FOR CODING CLASSROOM INTERACTION

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Introduction

The Munby System for coding classroom interaction is described in Mirrors for Behavior III: An Anthology of Observation Instruments, edited by Anita Simon and E. Gil Boyer. This observation system was constructed to study the intellectual consequences of varying kinds of science teaching behaviors, and it consists of two dimensions. One assesses the view of science which the teacher teaches either "realism," where the teacher talks about "scientific entities" (like ions, charges, genes) "as if" they were real, as contrasted with "instrumentalism" which talks about scientific concepts "as if" they were models which may be more or less useful than other models to describe the world. The second dimension assesses the teacher's provision for the intellectual independence or dependence of the student. The student is said to be intellectually independent when he has all the resources necessary for judging the truth of a knowledge claim independently of other people, and, in contrast, the student is said to be dependent when he must rely on someone else's authority.

The initial use of the system called for making judgments about small portions or "episodes" of teaching, rather arbitrarily determined from a transcript of the teaching in question. Recent work with the system to determine its validity resulted in a change in the scoring technique, principally to permit one to code a lesson directly or from a recording. The purpose of this manual is to describe this new coding procedure in detail. The description opens with general directions for using the scoring sheet. These are followed by detailed descriptions of how the classifications are to be interpreted for the Instrumentalist-Realist dimension. This is followed by a brief guide to the use of the Intellectual Independence and Intellectual Dependence dimension. An annotated bibliography is provided which includes references to the Munby System and to works which are related to this approach. The Munby System itself is appended.

General Directions

The general directions for scoring a lesson using the Munby System assume that a coder can assess classroom interaction at thirty-second intervals, and that for the Instrumentalist-Realist dimension of the system, he can judge a thirty-second portion of teaching as belonging to one of the following five categories:

I_2 - very instrumentalist

I_1 - somewhat instrumentalist

0 - intermediate; irrelevant or managerial

R_1 - somewhat realist

R_2 - very realist.

These categories are described in detail later in this document. It will be seen that the categories appear on the Munby System Scoring Sheet (on the following page). This sheet is used as follows.

1. The information required to identify the lesson being scored is entered at the top of the sheet. An assigned number is used for identifying the teacher when the instrument is used for research in which anonymity is important. "Class" should reflect the grade and subject (e.g. Grade 10 Science. "Lesson" is for a brief description to identify the lesson (e.g. Introductory Electrostatics).

2. Each scoring sheet can accept 15 minutes of scoring. As each sheet is started, the appropriate box under "Minutes" is checked so that the sheets for a total lesson are kept in proper order.

3. The lesson is scored by making a single "X" at each half minute interval in the appropriate category. The space for comments to the left of the columns permits the scorer to make qualitative notes, if he wishes, of specific features of the thirty seconds of dialogue which led him to score as he did. (This practice is especially useful for training scorers when some record is needed for comparing the work of two or more coders. It is also useful for noting the words used by the teacher at the points when scoring starts and stops, so that other observation schemes used in the same lesson can be made to synchronize.)

4. The total score for a coded lesson is found after determining the "I" (Instrumentalist) and "R" (Realist) score on each page of the scoring sheets used. The pages are completed by finding the total of "X" marks in each category. Since I_2 is defined, as described later, as very instrumentalist, it has a value of 2 x I. A check mark or "X" in category "O" is half of I. and half of R. Thus "This page I" is computed from $2 \times I_2$ -- $1 \times I_1$ -- $\frac{1}{2} \times O$. "This page R" is determined similarly. Enter "This page" I and R scores in the appropriate places in the boxes at the lower right hand side of the Scoring Sheet. Enter also the previous cumulative, if appropriate, and derive the cumulative for the page in question. These cumulative scores are transferred to the following scoring sheet.

5. Each sheet is treated similarly and in order, so that the final page for a coded lesson has cumulative I and R scores for the whole lesson.

6. The overall score for the coded lesson is found by adding the final cumulative I and R scores to determine the total number of points awarded in the lesson. The fraction of

MUNBY SYSTEM SCORING SHEET

(View of Science Dimension)

TEACHER NO. _____ DATE _____ CLASS _____ SUBJECT _____

SCORER _____

MINUTES + ☐ 0 ☐ 15 ☐ 30 ☐ 45

COMMENTS	I_2	I_1	O	R_1	R_2	TIME
						½
						1
						1½
						2
						2½
						3
						3½
						4
						4½
						5
						5½
						6
						6½
						7
						7½
						8
						8½
						9
						9½
						10
						10½
						11
						11½
						12
						12½
						13
						13½
						14
						14½
						15
TOTALS	___	___	___	___	___	

I: 2 x ___ =

1 x ___ =

½ x ___ =

This page I =

R: ½ x ___ =

1 x ___ =

2 x ___ =

This page R =

	PREVIOUS CUMULATIVE	THIS PAGE	TOTAL
I			
R			

MUNBY SYSTEM SCORING SHEET

(Intellectual Independence Dimension)

TEACHER NO. _____ DATE _____ CLASS _____ SUBJECT _____

SCORER _____

MINUTES + ☐ 0 ☐ 15 ☐ 30 ☐ 45

COMMENTS	II_2	II_1	O	ID_1	ID_2	TIME
						½
						1
						1½
						2
						2½
						3
						3½
						4
						4½
						5
						5½
						6
						6½
						7
						7½
						8
						8½
						9
						9½
						10
						10½
						11
						11½
						12
						12½
						13
						13½
						14
						14½
						15
TOTALS	___	___	___	___	___	

II: 2 x ___ =

1 x ___ =

½ x ___ =

This page II =

ID: ½ x ___ =

1 x ___ =

2 x ___ =

This page ID =

	PREVIOUS CUMULATIVE	THIS PAGE	NEW
II			
ID			

these points that are "R", converted to a percentage is the overall lesson score on the Realist dimension:

Or, REALIST SCORE: $\frac{R_t}{R_t + I_t} \times 100\%$

Where R_t and I_t are the final cumulative or total R and I scores for the lesson.

Description of the Categories

Lessons are coded with the Munby System by attending to the presence of "cues" which are listed beneath each dimension of the System itself (as given in the appendix) and by judging each half minute of interaction as I_2, I_1, O , R_1 and R_2, as noted above. These categories are described below to enable scorers to use the system accurately.

I_2 - Very Instrumentalist

Statements that fall into the I_2 category may be of two types. The easier type to detect is an overt statement about the nature of scientific reality, or about scientific models or "objects" which is in keeping with the instrumentalist position. Statements which make it clear that science is one of several competing explanatory modes, statements which specifically delimit the explanatory power of science, statements which specifically note the ontological differences between scientific and common-sense objects of perception are all statements of this type. They are global in scope, and distinctly instrumentalist in nature.

The second type within this category is closer to I_1 and hence slightly harder to distinguish. It contains statements about the nature of models, theories and the like, but in reference to a model which is being developed. Statements such as "If this model is any good ...", "We can check the correspondence between our model and ..." and "We will have to discard this model if it proves inadequate" are examples of this type. They deal with the model as a whole rather than with models in general. It is not essential to be able to distinguish between the two types for scoring purposes except that being able to internalize the entire scale with its extremes as accurately as possible will probably lead to finer scoring discriminations.

Etymology may be used in such a way that it would score I_2 as well. If the explanation is specifically congruent with the notion that a theory is man-made rather than an inevitable happening, and that the language supports this point, then the scoring is I_2. For example, "The word electric was used simply because it was a Greek name for a group of substances all of which showed some peculiar, but unexplained property ..." falls into this class. It is significant that to merely classify or name something does not explain it.

Score I_2 statements by placing "X" in the I_2 column of the Munby System Scoring Sheet.

I_1 - Somewhat Instrumentalist

Whereas I_2 statements could be judged "cold", more contextual information is needed for the I_1 category. For example, consider the etymological example of the last section. If the emphasis that a theory is a man-made entity is not clear, but the explanation is within an instrumentalist context (see the following) then the score would be I_1 rather than I_2. Simple definitions of a word-explaining nature within an instrumentalist context would likewise be scored I_1.

While I_2 statements dealt with general characteristics, I_1 statements deal with specific model or theory development. If a specific model is being developed, and the previous body of the lesson has been established as being instrumentalist by the presence of I_2 statements, then statements about the requirements of the model being developed will be I_1. It is understood by context that if the model-building activity is not successful, then the model can be discarded. Hence the context is necessary to ensure that we are scoring on the proper side of the 0, or midway point, of the scale. Exercises in model building, the performing of demonstrations, listing of correspondences between model and the observed, would all fall into this category. The context is necessary to distinguish I_1 and 0 categorizations. If there is no specific context, then experiments and demonstrations would fall into class 0 rather than I_1. Similarly, if natural history is being used in an instrumentalist context, it would score as I_1. (It could also score as 0 or R_1 as discussed below.)

In class discussion, distinctions made between theoretical statements and observations would be I_1 statements. Interaction which is obviously "setting up" for a discussion of the nature of explanation or the distinctions between data and concepts would also score I_1. This is a kind of before-the-fact context establishing, but can be identified by a trained observer. It is helpful to compare the preparation (I_1) to the making of the statement (I_2).

Statements regarding the implications of a theory, either suggested or tested, would score as I_1.

A typical instrumentalist oriented lesson might begin with an I_2 level discussion about the nature of models, follow with an I_1 level section of model-building, and conclude with an 0 level section of lab work or homework.

Score I_1 statements by placing "X" in the I_1 column of the Munby System Scoring Sheet.

O - Intermediate

This category, marked with an X is for interaction which might be judged R or I. (It is not to be confused with "Irrelevant or Managerial - - see below.)

As mentioned in the I_1 discussion, the context is important for distinguishing between I_1 and 0 judgments. It is also important for R_1 and 0 level discriminations.

Statements which have to do with the lesson content, but which show neither realist nor instrumentalist overtones would be classed here. Scoring should be made with the same mark, "X", as is used in the other four columns to indicate that it will be included in the final score calculation. Descriptive statements about equipment or materials would lie in this category. When a piece of equipment is being described, or its parts enumerated, or displayed, a score would be made in the 0 column. If the context of a given section of discourse is either neutral or indeterminate, then the statement belongs here.

Sometimes the scorer will be unsure about the position of a given time interval. This may be because (a) the context has not yet been established, or (b) the scorer had difficulty placing the context. The first type properly belongs in the 0 column. It is found that as one's scoring becomes more critical, there will be fewer instances of the second kind, and that more statements will be classed as I_1 or R_1 than initially was the case.

Sometimes science lessons are actually natural history lessons. That is, they are not explaining anything, but rather are setting forth straight history, or descriptions of phenomena. Such lessons, or portions thereof, would be scored here as intermediate.

A problem that exists is the temporal duration that should be considered for context establishment. For I_2 and R_2, of course, context is not a problem. But the three categories I_1, 0, and R_1 all depend upon knowledge of context for accurate judgment. If the contextual time span is increased, then the number of statements classified as R_1 or I_1 will increase at the expense of the number of level). It is believed that the context-establishing time span should be fairly long, such that scored level 0 statements are only descriptive ones if possible. The effect of this will be to make the scores somewhat more extreme. In other words, overall score variance is amplified as a consequence of increased discrimination between I and R.

Score intermediate statements by placing "X" in the 0 column of the Munby System Scoring Sheet.

O - Irrelevant or managerial

For anything described in this part, mark "-" in the O level column so that such tallies will not be included in the final calculation. (It is worthwhile to have these scores indicated

even though they will not affect the data because they ensure that the time flow of the lesson is not interrupted. Thus it is easier to locate a given section of the lesson if this becomes necessary.)

Managerial:

Managerial items include attendance taking, general office announcements, class announcements, homework checking (to see if it is completed, not taking up) and the like.

Time slots which are unscorable because of excessive noise, recording problems, fire alarms, searches for chemicals or materials, assembling of equipment without scorable commentary, prolonged blackboard writing without scorable commentary and the like will also be scored "-".

Two problems can arise in using this category. First, when should scoring begin? It is possible either to start scoring immediately when the teacher enters the room (using the number of "-" marks required) or to wait until some signal is given that the lesson is about to begin (and then use the number of "-" marks required.) The latter approach is favored, although the difference will probably not be significant.

Second, periods of noise or other unscorable periods do not usually confine themselves neatly to a scoring period of thirty seconds. If an unscorable time occurs which is about 25 seconds in length then the time should be scored "-", and the balance of that interval should be included with the succeeding interval to be scored. Similar small temporal irregularities may be encountered in other situations. The goal of the observer should be to score as accurately as possible every half minute without reducing the validity of his results. If it is felt that a shift of a few seconds will result in a more valid score, then this should be done, bearing in mind that the increasing discrimination results in amplifying the variance.

Score Irrelevant or Managerial Statements by placing "-" in the O column of the Munby System Scoring Sheet.

R_1 - Somewhat Realist

If a statement is not necessarily realist all on its own, but is within a realist context, then this is where it belongs. For example, definitions supplied within a realist context would score as R_1, whereas definitions supplied in a neutral context, or simply for operational convenience (generally with a note that the meaning will be pursued in more detail later) would score O.

Situations wherein realist premises are worked from would score R_1. Hence theory-building in the didactic sense of "here is how it works" scores here, as would statements in biology about how things function. Typically these sorts of statements arise when the difference between correlations and explanations is not made clear. "Newton's second law tells us that ..." is stated

in explanatory form, leading one to believe that matter is forced to conform to particular scientific principles. This implied immutability of scientific truth expresses a realist position. Similarly, speaking of seeing properties that one cannot see as though they were observable phonomena is a realist set. For example, "We can see that lead has a greater affinity for oxygen than has mercury" states an idea in observational form.

Natural history can also score here if the perspective is one of presenting older or discarded theories as being inaccurate or wrong accounts of reality. It will be observed that natural history now appears in three categories in this scheme. All of them are context dependent.

Finally, R_1 is the correct score when concepts or symbols are introduced for the sake of organizational convenience, even though they are significant concepts or symbols, their significance is not mentioned, or at least the fact that they are significant is not mentioned. For example, suddenly introducing words such as "force, energy, power" as part of an explanation of something else when the students would not be familiar with the precise meaning that the teacher applies to these words promotes a realist understanding. Similarly, an unexplained introduction of coefficients and subscripts into chemical equations would require R_1 scoring.

Score R_1 statements by placing "X" in the R_1 column of the Munby System Scoring Sheet.

R_2 - Very Realist

The basic criterion for statements of this category is that they can be scored as being realist without regard to context. Statements such as "It takes the electrons from ... and puts them ... and holds on to ..." assume very clearly the physical reality of what the instrumentalists class as postulated entities. This if found to be the most common statement type in this category. Overt statements of the following types would also score here: "That old theory is wrong, but the new one is right", "Science is really the only viable way to explain this", and "Anything can be explained scientifically if enough data can be collected".

Unexplained anthropomorphisms also score here. To say that electrons "like" to occupy certain orbits, orbitals, or regions of space because the energy requirements are lower, or that electrons "don't like" to be paired up is to make a statement of this type. (To say "it is handy to think of ... as showing electron greediness" is not a statement of this type because the use of a convention has been signalled, which is instrumentalist.)

Categorization into the R_2 group is essentially based upon the degree of covertness. When the statement is obviously realist,

and can be understood as such in virtually any context, then R_2 is the appropriate score. The difference between this category and R_1 is parallel to the differences between I_2 and I_1.

Score R_2 statements by marking "X" in the R_2 column of the Munby System Scoring Sheet.

The Intellectual Independence Dimension

The second dimension of the Munby System permits one to score a lesson for the provision it makes for Intellectual Independence or Intellectual Dependence. A lesson can be scored on this dimension by using the Munby System Scoring Sheet designed for this purpose.

Scoring, and computing proceed as before, the scorer relying upon the cues provided in the Munby System for this dimension. Using guidelines similar to those describing the differences between Very Instrumentalist and Somewhat Instrumentalist, the scorer can discriminate between Very Intellectual Independence and Somewhat Intellectual Independence, and between Very Intellectual Dependence and Somewhat Intellectual Dependence.

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Annotated References

MUNBY, A.H. The provision made for selected intellectual consequences by science teaching: Derivation and application of analytical scheme.
Unpublished doctoral dissertation, University of Toronto, 1973.

The theoretical background to the Munby System receives full treatment here. The Dimensions of the System are shown to be derived from three major sources: philosophy of science, epistemology, and conceptual analyses of the concept teaching.

MUNBY, A.H. Munby system. In A. Simon & E.G. Boyer (Eds.) Mirrors for behavior III: An anthology of observation instruments.
Wyncote, Pennsylvania, Communication Materials Centre, 1974.

The Munby System is described here, and useful examples to show the coding of specific statements are given.

MUNBY, A,H. Some implications of language in science education. Science Education, 1976, 60, 115-124.

This paper provides a general background to the Instrumentalist and Realist position, and offers arguments about the potential consequences to learners of communicating science as either Instrumentalist or Realist.

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This is a preliminary report of an attempt to determine the validity of the View of Science dimension of the Munby System.

MUNBY, A.H., Analyzing teaching: The quality of the intellectual experience and the concept of Intellectual Independence. Paper presented at the annual meeting of the National Association for Research in Science Teaching, Cincinnati, March, 1977.

A briefer account of the concept Intellectual Independence is given here, together with an outline of its development.

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A complete account of the validity study on the View of Science dimension of the Munby System.

ROBERTS, D.A., and RUSSELL, T.L. An alternative approach to science education research: Drawing from philosophical analysis to examine practice. Curriculum Theory Network, 1975, 5, 107-125.

The paper reviews six uses of philosophical analysis to examine science education phenomena.

MUNBY SYSTEM

Dimension 1: View Of Science Provided For

R - REALIST:

a. Theories are stated as if they have the same logical status as observation statements.

b. "Scientific objects" (postulated entities) are talked about as if they have the same ontological status as common-sense objects of perception. They have a physical reality.

c. Science presented as the only acceptable way of describing or explaining the world or phenomena.

d. Science spoken of as superior to alternative explanatory modes.

e. Past theories are presented as false.

f. Lapsed "scientific objects" given as inaccurate accounts of reality.

g. The potential of science for explaining or describing is given as unlimited.

h. That a model, law, theory, or convention is being used is not signalled to pupils.

i. A model, law, theory, or convention is invoked as description of phenomena.

I - INSTRUMENTALIST:

a. Theoretical and explanatory statements are stated as if they have a logical status different from that of observation statements.

b. "Scientific objects" presented as having a different ontological status from common-sense objects of perception. They are postulated entities.

c. Science presented as one way of explaining the world or phenomena.

d. Science spoken of as in competition with alternative explanatory modes.

e. Past theories presented as inadequate.

f. Lapsed "scientific objects" given as inadequate explanatory devices.

g. The potential of science for explaining and describing is given as limited.

h. That a model, law, theory, or convention is being used is signalled to pupils.

i. A model, law, theory, or convention is invoked as an explanation of phenomena.

MUNBY SYSTEM (continued)

Dimension 2: Provision For Intellectual Independence Or Dependence

II - INTELLECTUAL INDEPENDENCE:

a. Evidence is provided in support of claims.

b. The argument is present.

c. Correspondence of diagram or model to phenomena is demonstrated by argument and evidence.

d. Adequate reasons given for the acceptability or unacceptability of a pupil's statement or response.

e. Suggestions, questions, and objections of pupils are honored and are treated with regard to reason.

f. Pupils have provision to make judgments of the viability of models, theories, and explanations by recourse to phenomena.

g. Alternative models, theories, and explanations are provided to permit pupils to make judgments among them.

h. Discrepancies among observations or evidence are rationally resolved.

ID - INTELLECTUAL DEPENDENCE:

a. Evidence is not provided in support of claims.

b. The argument is absent.

c. Correspondence of diagram or model to phenomena is not demonstrated by evidence or by argument.

d. Adequate reasons for the acceptability or unacceptability of a pupil's response are absent.

e. Suggestions, questions, and objections of pupils are not honored or are not treated with regard to reason.

f. Provision is not made for pupils to make judgments of the viability of models, theories, and explanations by recourse to phenomena.

g. The making of judgments among alternative models, theories, and explanations is preempted since alternatives are not provided.

h. Discrepancies among observations or evidence are not resolved on rational grounds.

From A. Hugh Munby, "The Provision Made for Selected Intellectual Consequences by Science Teaching: Derivation and Application of an Analytical Scheme." Unpublished Ph.D. dissertation, University of Toronto, 1973. © Copyrighted.